September 1967

Brief 67-10323

NASA TECH BRIEF

Computer Program Utilizes Fortran IV Subroutines for Contour Plotting

A computer program has been developed that constructs lists of xy-coordinate pairs that define contour curves for an arbitrary given function of two variables and transmits these lists to plotting equipment to produce contour plots.

To use the program, the following information must be supplied: Let f(x,y) denote the function to be contour plotted. The user must incorporate code to compute z=f(x,y) in his main program. This may involve calls to subroutines, change of variables, table look-up, interpolation, I/O activity, etc. The user defines the rectangular domain of interest by specifying XMIN, XMAX, YMIN, and YMAX. The resolution, and consequently the machine execution time, is controlled by specifying NX and NY, the number of equally spaced evaluation grid lines to be used in the x and y directions respectively. Function values $Z_1, Z_2 \ldots, Z_n$ are specified for which contours are desired.

The principal subroutine, CONTUR, which constructs the contour lists, is independent of any specific system of plotting subroutines and equipment. All calls to such system-specific subroutines (e.g. the JPL SPLOT system for using the SC4020 plotter) are isolated into two short subroutines which can easily be changed for use with other systems. The subroutine CONTUR could be used in connection with applications other than plotting e.g. maximum seeking. Usage is simple; the new programming needed to obtain a contour graph of a new function consists of little more than the code to evaluate the function.

A grid scanning approach is used rather than a curve following method. Resolution depends entirely on the fineness of the grid specified by the user. Since a curve following method must include some form of scanning to avoid missing isolated curves, it is believed that the approach used here is more efficient than curve following when graphic display is the desired end product. For applications requiring extreme precision, the contours produced as above could be refined by gradient methods or by reapplication of CONTUR, using a finer grid or smaller regions containing the curves of interest.

The number of function evaluations NX × NY, is fixed by the user's specification of NX and NY and, in particular, is independent of the number of different contour values requested. It is not necessary to be able to store the entire matrix of NX × NY grid values simultaneously. An array of (NX + 2) words provides all the space needed to save values at grid points.

The construction of contour strings uses list processing techniques, so it is not necessary to anticipate the number of distinct contour curves or the number of points per curve. If the storage available for the contour strings becomes exhausted, the subroutine interrupts processing so that the strings can be sent to the basic plotting subroutines before processing is resumed.

Positive identification is maintained for distinct contour curves thereby permitting positive control of curve labeling. Each closed curve is labeled at one point and each nonclosed curve is labeled at the two points at which it intersects the grid boundary. Provision is made for the user to exclude specified lattice points of the evaluation grid. This permits treatment of irregular boundaries.

Notes:

1. This contour plotting system has been in use at JPL for two years in a variety of applications.
2. Machine requirements are an IBM 7090/94 and an SC-4020 plotter.

(continued overleaf)

3. These subroutines are written in Fortran IV using the JPL SPLOT system of plotting subroutines.
4. Inquiries concerning this program may be directed to:

COSMIC
Computer Center
University of Georgia
Athens, Georgia 30601
Reference: B67-10323

Patent status:

No patent action is contemplated by NASA.

Source: C. Lawson, N. Block, and R. Garret
Jet Propulsion Laboratory
(NPO-10127)